

# Australasian Plant Conservation

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ANPC Conference issue:  
Seeds to recovery

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**Front cover:** Lindsay with drying seed  
of Ruby Saltbush (*Enchylaena tomentosa*)  
at the regional seed bank managed  
by Murray Local Land Services.  
Photo: Amelia Martyn Yenson

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# From the editor

HEIDI ZIMMER

We begin this, the Australasian Plant Conservation Conference 'Seeds to Recovery' issue, with a thoughtful and informative summary of the conference put together by Christine Fernance and Amelia Martyn Yenson. Then we dive into a swag of articles based on conference presentations. First we have an article from Natasha Lappin and others, who describe their experiences in native seed management in southern NSW and northern Victoria, highlighting the achievements of the Murray and Goulburn Broken seed banks, and calling for more consistent resourcing of the sector. Next, John Delpratt and David Franklin share the story of the successful restoration of native grassland on a roadside in western Victoria. This is followed by an article from Sam Andres and others, who introduce us to the cutting edge of seed-based restoration – using drones and seed pods! This technology is being trialled to restore areas previously affected by dense African Olive infestation to Western Sydney Dry Rainforest and Cumberland Plain Woodland species at the Australian Botanic Garden Mount Annan.

Heading south, Rick Davies *et al.* take us to Kangaroo Island (KI) and the monitoring for 17 plant species that are endemic to KI and were affected by bushfire in January 2020. Of particular interest is the range of threats, and their varying impacts on the threatened species. For example, after the fire, *Asperula tetraphylla* was impacted by weeds and feral pigs, the population increased after hand weeding and fencing, only to be reduced again by flash flooding. Next in the conference articles, and on a topic which inspired much discussion at the conference, Chantelle Doyle presents an article which dives deep into the concept of “engagement”. Chantelle asks, when it comes to plant conservation and ecological restoration, what is engagement, and what drives people to engage? Last, we have an article from Lucy Commander, who gives us an overview of the updated Florabank Guidelines.

We move then to our regular features. In news from the Australian Seed Bank Partnership, Damian Wrigley *et al.* return to the theme of Myrtle Rust, this time discussing the role of *ex situ* collections, and a member profile, book review, then ANPC news.

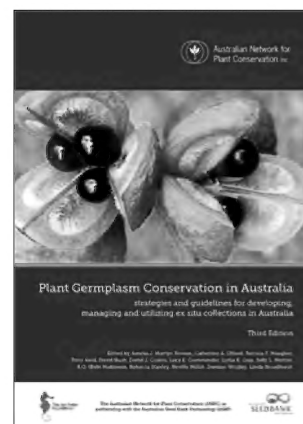
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# APCC13 conference summary

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From Sunday 3 to Thursday 7 April 2022 we held our 13th Australasian Plant Conservation Conference in Albury, NSW. We had 91 people join us in person at the Albury Entertainment Centre. We also had a further 54 attendees join us online for the plenary sessions and workshops. Two thirds of our audience were from NSW or Victoria with delegates also joining us from the ACT, WA, Tasmania and Queensland.

Our conference was opened by a welcome to country from Wiradjuri elder, Aunty Edna Stewart, followed by opening addresses from Albury Councillor Ashley Edwards, NSW Member for Albury Justin Clancy, and the Federal member for Farrer and Minister for the Environment Sussan Ley. Then before we delved into the plenaries, Dr Tony Auld gave the ANPC President's address. Tony's address touched on the megafires of 2019/20 and highlighted how this conference gave us the chance to examine and reflect on recovery following the fires and discuss how best to engage others in plant conservation moving forward.

## The Plenaries

Under the overarching theme 'Seeds to Recovery' 63 speakers covered topics under four conference subthemes:

**1. Bushfire recovery** – This subtheme explored both the impacts of the 2019/2020 fires on native plants and their recovery after fire. Beginning with Professor Rachael Gallagher's keynote on the mega-challenges for Australian plant diversity, this theme took us to Kangaroo Island and south-eastern NSW to look at

post-fire recovery. We also explored management of temperate grasslands, self-determination and practice and the need for restoration in fire-affected landscapes. Talks in this theme also highlighted species-level recovery and the need to collaborate for conservation.

**2. Seeds** – Knowledge of seeds can help optimise the seed supply chain for restoration, and hence improve restoration outcomes. This theme kicked off with a keynote from Dr Mark Ooi discussing the persistence of seeds and plant species under shifting fire regimes. The following presentations were a varied mix aiming to inspire and inform those who work with seeds. This included a data framework to predict seed germination under a changing climate to native plant restoration on Norfolk Island and the excellently named 'There are giraffes in the seed orchard – again!'

**3. Conservation / threatened species and communities** – This theme explored threatened species conservation, showcasing both *in situ* and *ex situ* programs addressing the threat of extinction. It also provided an opportunity to explore partnerships supporting species survival. Dr Nathan Emery opened subtheme three with a keynote on combining *ex situ* and *in situ* research to achieve conservation outcomes of threatened species and communities. We then heard from a range of speakers discussing orchid conservation, using genomics to conserve a rainforest species, tackling plant conservation within a botanic garden and how *ex situ* collections can be used for conservation and translocation of Australian natives.



Conference audience. Photo: Christine Fernance

4. Engaging people with conservation / restoration –

Our final subtheme explored the various engagement approaches used throughout Australia. Our guest speaker, Jonica Newby, opened this session with a discussion on her recent book *Beyond Climate Grief*. We then had the chance to get involved and give our opinions in Chantelle Doyle’s keynote on why people get and stay involved in conservation projects. Our final presentations at the conference were given by Christine Allen and John Delpratt, ending on a positive note with a story on reseeded native grassland in Victoria.



Theme 2 presenters answer questions from the audience (recording screenshot).

Workshops

The conference included workshops on the Monday and Tuesday afternoons, each with a series of short presentations and audience engagement via discussion and polls.

Workshop 1: Meeting ambitious restoration goals in the UN Decade on Ecosystem Restoration: National, State and Local Scale

This workshop was facilitated by Damian Wrigley, National Coordinator of the Australian Seed Bank Partnership, and planned in conjunction with Sam Craigie, Greening Australia’s Project Phoenix coordinator, and Dr Amelia Martyn Yenson (ANPC). The session opened with presentations from Dr Emma Ladouceur on *The Global Restore Project: Knowledge Sharing for Shared Success* and Dr Blair Parsons (Greening Australia) on *Viewing ecological restoration through an impact lens to generate benefit in landscapes*. Martin Driver (ANPC) and Sam Craigie gave an overview of project outcomes from Healthy Seeds (NSW) and Project Phoenix (Australia) which identified the need for urgent, coordinated action to scale up seed collection, production, storage and delivery. Dr Paul Gibson-Roy (restoration ecologist) and David Carr (Stringybark Ecological) invited participants to consider the sector and industry challenges and constraints, respectively, in meeting these needs. Damian Wrigley spoke about the Australian Seed Bank Partnership’s impact locally and

globally in meeting conservation and information needs. Finally, Dr Libby Rumpff (University of Melbourne) presented a state and transition model to assess site needs and measure success in the Goulburn Broken catchment.

Polls captured the many ways in which attendees were already involved in restoration action, and their future needs for resources, information sharing and training.

Attendees already played a range of roles in the sector. Most attendees were researchers (24), seedbank managers, restoration practitioners or part of a community group (10 each). We also had native seed collectors, consultants, students, landholders and nursery personnel in the audience.

Most workshop attendees were part of local projects or research, followed by coordination activities and the development of SERA, Florabank, Translocation and Germplasm Guidelines.

One of the outcomes of Project Phoenix was the development of A Strategy for the Australian Native Seed Sector. We asked participants to select their 3 main areas of interest under the Strategy’s six objectives. Here is what they chose:

	No.	%
Information sharing	50	28
Quality	44	24
Sector leadership	27	15
Smarter regulation	25	14
Market coordination	19	11
New industries	15	8

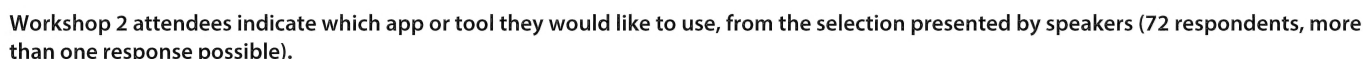
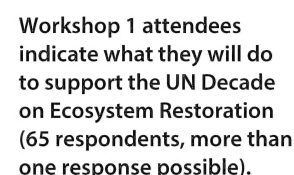
Future action by attendees, to meet the goals of the restoration decade was captured, reflecting the mix of sector roles held by participants in the conference workshop.

We ended the workshop by asking “What do you see as key tools, resources or knowledge needs to assist restoration?”

With 100 respondents, the top suggestions were long term funding, education and training opportunities, and cultural/First Nations knowledge. Information sharing was again a key theme, with suggestions for a centralised knowledge hub and databases.

Workshop 2: Selecting species and provenances: a showcase of tools, templates and approaches

This workshop was facilitated by Professor Maurizio Rossetto (Research Centre for Ecosystem Restoration, Australian Institute of Botanical Science) and Martin Driver (ANPC), with input from Linda Broadhurst, Marlien van der Merwe and Dr Amelia Martyn Yenson at the planning stages. Workshop 2 was structured as a showcase for a variety of web-based tools, apps and templates for selecting species and provenances.



Issues with field application of the demonstrated tools include technical problems such as lack of reception in the field and battery life of devices; data issues such as identification of naturalised and non-native species in lists; and communication gaps that mean practitioners need better support to utilise the applications available.

Our delegates had a choice of two field trips to attend on Thursday 7 April. One group headed west and visited seedbank facilities in Deniliquin and looked at Seed Production Areas along the way. Those who chose to head east started on the Victorian side of the border to look at the extent of recent wildfires and discuss associated restoration, weed incursion and grazing management. These field trips were generously supported by Murray LLS and North East CMA.

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Lindsay with drying seed of Ruby Saltbush (*Enchylaena tomentosa*) at the regional seed bank managed by Murray Local Land Services. Photo: Amelia Martyn Yenson

### APCC13 recordings

In respect for the presenters' time and effort, and the delegates who paid to attend, video recordings of the presentations and workshops are currently available only to APCC13 registered delegates (in-person and online), and those who purchase access to the recordings (a discount is available for ANPC members). Please follow the links below for more information: <https://www.anpc.asn.au/conferences/apcc13/recordings/>  
<https://www.anpc.asn.au/product/apcc13recordings/>

### Final remarks

We received some great feedback in our Evaluation Survey on the topics and presenters (as well as the catering!). We really appreciate getting our delegates' feedback and for the next conference we will be focusing on making the workshops more interactive, facilitating more formal networking and mixing in activities to break up the day.

We look forward to seeing everyone again for the next Australasian Plant Conservation Conference to be held in 2024!

### Acknowledgements

On behalf of the ANPC, we'd like to thank all the presenters, facilitators and field trip leaders, along with the major conference partners who helped make this conference possible: in particular the New South Wales Government and the Australian National Botanical Gardens as Gold partners; Greening Australia as Silver partner; the Australian Institute of Botanical Science as a Speaker partner; Murray Local Land Services and the North East Catchment Management Authority for supporting the Field Trips; and the Australian Flora Foundation for supporting the Conference Dinner.

We would also like to thank the efforts of the conference organising committee for making this such a successful event: Rachael Orr, Ros Walls and Nerilee Kerslake of Albury City Council; Damian Wrigley from the Australian Seed Bank Partnership; Jodi Price from Charles Sturt University; Jim Begley of Goulburn Broken CMA; Judy Kirk of Landcare – Corowa District; Natasha Lappin of Murray Local Land Services; Phillip Falcke of North East CMA; Lucy Commander of the University of Western Australia; Singarayer Florentine from Federation University and ANPC Committee member. In addition, thanks to Robert Hawes the ANPC Office Volunteer for all his hard work supporting the conference including the sending of many last minute receipts!

# Scaling up native seed supply in southern New South Wales and northern Victoria, Australia

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Sustainable, ethical native seed supply which supports large scale revegetation is fundamentally critical to tackle issues such as threatened species, habitat loss, climate change and flora conservation in Australia.

Native seed management, storage, processing and establishment of Seed Production Areas (SPAs) are key to ensuring a healthy native seed supply for the revegetation industry into the future. This article

explores two examples of regional-scale seedbanks in both the New South Wales (NSW) Murray region and Goulburn Broken catchment in Victoria. Both regions are undertaking a coordinated approach to ethical and strategic native seed collection from SPAs, with seed storage, treatment and data management systems as part of that process. Issues associated with this model are identified and show how critical regional seedbanks are in implementing revegetation (habitat) at scale.

The backbone of operating regional seedbanks is the ability to source, clean and store large quantities of healthy, genetically diverse seed. Both seedbanks utilise networks of native SPAs that have been specifically planted to achieve this goal. The benefits of SPAs include the ability to collect a high volume of native seed annually, maximising genetic diversity through the strategic collection in the field, and planting of a broad range of once-connected populations. This specific seed production technique therefore results in: increased availability of species and bulk seed (kg); a reduced impact on wild flora populations; improvement in efficiencies in seed collection and processing; and reduced overheads (i.e., fuel, travel and labour costs). It really is a win-win. The ability to collect large amounts of native seed from remnant plant populations is declining for many reasons, so the importance of SPAs cannot be underestimated. By reconnecting fragmented populations of species through seed production, the outcome is a stronger, more adaptable population to use in future revegetation programs.

One issue faced in the Murray region is the reduced number of productive SPA sites that are currently operational. At its peak, there were more than 75 active SPAs in the Murray region which resulted in more than 930 kg of seed being deposited into the seedbank in 2010/11. Almost all these early SPAs were established 10–15 years ago on private property where the landholder was paid for the seed that was collected from their SPA. Today, in the Murray region there are only 17 active SPAs and two new SPAs being planted in 2021/22. The average seed harvest deposit over the past three years from these SPAs has been just over 240 kg of seed annually. Increased variability in seasonal conditions adds to the challenge. Due to a lack of ongoing investment in maintenance and aging plants, most of these SPAs are no longer producing seed. Continued investment in SPAs is critical to enable the continued supply of quality and diverse seed for restoration.

State and federal governments, corporates and landholders are exponentially increasing the demand for seed through carbon and biodiversity projects (e.g., target for Victorian State Government is 200,000 hectares of revegetation by 2037, BIO 2037 Strategy 2021). There is substantial demand to upscale seed production, but there are several barriers limiting the potential to meet the quantity of seed required and therefore a future supply deficit is highly likely.

These barriers to the Murray region's ability to meet the quantity of seed required include that seedbanks are under-valued financially and undervalued for their work as the critical factor to the region's ability to deliver revegetation and habitat programs for funders. There is very little support in financing regionally based staff to strategically plan and coordinate seed supply on the ground and the requirement for seed in project planning



*Enchylaena tomentosa* Ruby Saltbush. Photo: Natasha Lappin



Gargarro Botanic Gardens seed production site, Victoria. Photo: Jim Begley

is often overlooked and not planned accordingly, resulting in an assumption that seed will be available to deliver desired revegetation targets.

Murray is the only Local Land Services region in NSW operating an established seedbank and also a direct seeding service, while the Goulburn Broken Indigenous Seedbank at Euroa is the only established seedbank in the Goulburn Broken catchment. The Murray LLS seed vault is a temperature and humidity-controlled room that has the capacity to hold up to 3.5 tons of seed. Murray Seed Services employs two part-time staff and has a team of eight casual staff who are employed on a seasonal basis as seed collectors over the summer months. Maintaining skilled staff, especially casual staff who are employed on a seasonal basis is a



challenge. Seed collection is heavily targeted to species that can be utilised through direct seeding, with more than 95 per cent of the seed collected by Murray Seed Services going to this purpose. Direct seeding is a service provided by Murray Local Land Services on a fee-for-service basis and is fundamentally important in being able to revegetate large scale areas efficiently and cost effectively. The enormous annual variability in demand for this service makes it challenging to consistently meet the operating costs of providing the service.

Kim Wilson and Cath Olive from the Goulburn Broken Indigenous Seedbank at Euroa, Victoria reflect on the barriers encountered in running a not-for-profit Seedbank in Victoria.

*“Currently we are harvesting 140 kilograms of native seed per year which is roughly half the seed required for annual revegetation demand. Wild seed harvest is time consuming and problematic. Not every season is favourable for seed collection; frequently there is poor seed set with dry conditions, or with early heat, seed aborts or ripens very quickly and we can miss collection. Seed harvest occurs over a wide area with extensive travel time. Indigenous seed and plant production is highly labour intensive. Many of the nursery growers are now in their 60’s or 70’s. Growing plants and seed selection require skill, in-depth plant knowledge and is physically demanding. We drastically need to train new, committed staff to meet the future demand. The bulk of the work in nurseries and seedbanks is undertaken by part-time staff and volunteers. The seasonal nature of the industry means it is difficult to offer continuity of employment, reasonable pay and long-term career paths. Much reliance is, therefore, placed on individuals who are committed to the need for indigenous revegetation, rather than seeking the reward their efforts deserve. The commercial realities of indigenous plant production and seed bank management are extremely poor. Although demand for indigenous seed and plants is potentially high, the lack of investment in people, infrastructure and, most importantly, land, means prices of seed and plants are insufficient. Consequently, it is difficult to build long term sustainable businesses without some external investment”.*

For such important work, we are far from meeting the supply chain for native seed. Adequate investment in the foundations of native seed supply to support the future needs of the planet needs to occur. With so much land cleared since colonisation, we are playing the long game of catch up, and we need a real commitment on ground and in project planning for seed supply, to support future rehabilitation of Country.

Seedbank storage, processing and establishment of Seed Production Areas is critical to ensure native seed supply to the revegetation industry. The Murray and Goulburn Broken seedbanks are examples of how this can be achieved but they require consistent resourcing to continue to provide and expand services, that are more equipped to meet present and future restoration needs, particularly the strategic habitat restoration targets set by the various levels of government throughout Australia.



Grassland species in raised benches at Euroa Arboretum.  
Photo: Cath Olive



*Kennedia prostrata* Running Postman. Photo: Jim Begley



# Restoring diverse native grassland in south-west Victoria by direct seeding – a success story

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Woorndoo is a village and rural district in south-western Victoria. It straddles Salt Creek, which flows from Lake Bolac, south to the Hopkins River. Salt Creek forms the boundary between the heavy basaltic clays of the Victorian Volcanic Plain (VVP) to the east and the sedimentary soils of the Dundas Tableland to the west. Despite the differences in soil parent material, the temperate grassland communities of the VVP and the grassy Eucalypt woodlands of the Dundas Tableland share many of the same herbaceous native grasses and forbs. Most of the district's farmland is dedicated to grazing exotic pasture for wool and meat production, or to extensive cropping. However, a network of wide, '3-chain' roads servicing Woorndoo and adjacent districts supports some of the largest and most species-rich remnants derived from the nationally significant Natural Temperate Grassland and Grassy Eucalypt Woodland of the Victoria Volcanic Plain.

Editor's note: In the 1800s much of southeastern Australia was surveyed to establish a network of roads. The width of these roads was measured in chains. One chain is 20.12 m, and roads were typically one to six chains wide.



Figure 1. Spring flowering in a diverse native grassland remnant on a '3-chain' road near Woorndoo in south-west Victoria, with an extensive canola crop (right) and a Sugar Gum (*Eucalyptus cladocalyx*) plantation sheltering grazing land (left). Image: John Delpratt

In 2012, the Woorndoo Land Protection Group (now Woorndoo Chatsworth Landcare Group) developed plans to restore a diverse native grassland community

on a 1.25 ha section of cropped roadside on the '3-chain' Woorndoo-Streatham Rd., Woorndoo. One of us (DF) had been a local Landcare member for several decades and had worked with Paul Gibson-Roy on the Grassy Groundcover Research Project for several years (Gibson-Roy and Delpratt 2015). Following the success of the GGRP in developing protocols for restoring diverse native grasslands by direct seeding, it seemed timely to engage his community in a local demonstration of the technique.

The project followed a five-step program.

1. Site selection
2. Seed sourcing
3. Site preparation
4. Direct sowing
5. Ongoing site management

## Site selection

The restoration site is on the corner of Woorndoo-Streatham Rd. and Bolac Plains Rd., on basalt-derived cracking clay soils, which are saturated during winter and hard and cracking during summer. It is at the south-western end of a more-or-less continuous stretch of approx. 10 km of annual roadside cropping of wheat and canola that had been in place for at least two decades. It is immediately adjacent to a very high-quality native grassland reference community along Woorndoo-Streatham and Bolac Plains Rds.



Figure 2. Roadside cropping on the Woorndoo-Streatham Rd., Woorndoo. Two or more decades of cultivation have resulted in a soil seed bank of annuals, dominated by Wireweed (*Polygonum aviculare*), Capeweed (*Arctotheca calendula*) and several annual grasses. Photo: John Delpratt



**Figure 3.** The Woorndoo restoration site in autumn 2021, adjacent to the species-rich Kangaroo Grass grassland reference community. The success of the 2013 restoration led to the funding of a further restoration of 1.25 ha in 2019, along with other associated grassland restoration projects. Photo: Max Roux

### Seed sourcing

Sourcing seed for diverse native grassland restorations is challenging and time-consuming. This project benefited from having some cultivated native grass and forb seed crops available (DF produces crops on his farm). However, many local volunteer hours of field seed collection were donated to acquire the species diversity and quantity needed for direct sowing. Grassland restoration projects may need lead times of one to three years to source sufficient quantities and diversity of seed, pending the development of regional seed production enterprises.

### Site Preparation

The site was prepared for direct sowing following the protocols developed by the GGRP (Greening Australia 2017). In autumn 2013, approximately 100 mm of topsoil was graded from the site (an in-kind contribution from Moyne Shire Council) to reduce elevated nutrient levels, particularly nitrogen and phosphorus, and to deplete the soil weed seed and bud bank. When compared to repeated cultivation followed by herbicide applications, this apparently radical process is extremely effective on relatively flat sites, free of surface rock and supporting little or no native vegetation. It provides an early and lasting competitive advantage to the sown native community over nutrient-loving exotic species (Gibson-Roy and Delpratt 2015).

### Direct sowing

The seed mix comprised eight grass species and twenty-two local herbaceous wildflowers (forbs) and grassland shrubs, all of which occur in nearby remnant communities. Seed, seed-bearing florets and stems were processed through a garden mulcher and homogenised. The site was sown using a modified turf aerator with oscillating tynes, which creates a shallow seed bed. The 'fluffy', non-flowable mix was spread uniformly across the site from a modified hopper and pressed onto the soil surface with a roller. By 2022, 60% of sown species had been recorded in the resulting community.



**Figure 4.** Seed sourcing and preparation. Clockwise from top left. Wallaby Grass (*Rytidosperma* sp.) field crop; Common Everlasting (*Chrysocephalum apiculatum*) field crop; field collecting Lemon Beauty-heads (*Calocephalus citreus*); diverse 'fluffy' seed mix ready for direct sowing. Photos: Paul Gibson-Roy and John Delpratt



Figure 5. Direct seeding previously cropped roadside on Woorndoo-Streatham Rd., Woorndoo, in mid-spring. The previous autumn, topsoil was removed to a depth of approx. 100 mm. Weed seedlings from the depleted soil seed bank were sprayed with broad-spectrum herbicide prior to sowing. Photo: John Delpratt

### Ongoing site management

The early establishment phase of this spring-sown native grassland was dominated by Wallaby Grasses (*Rytidosperma* spp.). This initial germination of C3 (cool season) grass was accompanied by numerous other species, including the C4 (warm season) Kangaroo Grass (*Themeda triandra*) and a suite of other grasses and forbs, particularly the common daisies. However, it was the dense sward of Wallaby Grass that probably had a key role in suppressing competition from the exotic species that remained on the site. It also provided an abundant annual seed harvest for subsequent sowings. Within one to two years, the forb component became well established, providing a spectacular spring and early summer display.

The site was burnt for the first time in autumn 2017 and again in 2021. In autumn 2018 and autumn 2020 it was cut and baled to reduce and remove biomass, in lieu of burning. Both management treatments reduce above-ground biomass, open potential recruitment gaps between the grass tussocks and lead to prolific flowering and seeding in the following spring and summer. This initial sowing experienced a series of dry summers during its establishment phase. The winter growing, spring and summer flowering daisies have flourished and spread throughout the site, while usually abundant species, such as Kangaroo Grass and some of the lilies, have taken several years to mature and flower. These same species are more abundant and have matured much more rapidly in the adjacent restoration, sown in spring 2019 – a sowing that has experienced a series of wet summers. However, almost nine years on, the 2013 sowing is rapidly transitioning to a diverse, Kangaroo Grass plains grassland.



Figure 6. Summer 2022, as the site transitions towards a diverse, Kangaroo Grass (green tussocks) dominated plains grassland. Image: Elizabeth Fenton

### Conclusion

This community-initiated grassland restoration on a cropped roadside has been an outstanding success. The Landcare group was able to obtain Victorian state government funding to undertake the restoration of a further restoration of 1.25 ha (2019), along with experimental tube stock plantings within the 2013 restored community. Our focus is now on adapting grassland restoration protocols to reconnect fragmented remnant communities, and on fostering increased regional seed production capacity so that these proven methods can be applied at scale.

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# New approaches with drones for restoring biodiverse native vegetation

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## Major challenges ahead for restoring ecosystems

Land degradation poses a significant threat to the health and integrity of native ecosystems, which is why the United Nations has declared 2021–2030 as the Decade on Ecosystem Restoration. Recent assessments indicate that up to 20% of the Earth's surface is degraded and requires restoration (Sutton *et al.* 2016). While there have been increased efforts globally to restore native vegetation, it is estimated that 1.9 million km<sup>2</sup> of land must be restored to meet the 17% global protected area target (Aichi Target 11) under the UN Convention on Biological Diversity (Mappin *et al.* 2019). However, the costs associated with most established techniques for revegetation and site access are major limiting factors to the achievement of this target. For example, there are high costs associated with most tubestock plantings which include the maintenance of greenhouse facilities and the employment of people, or purchase of dedicated machinery, to undertake restoration plantings in the field. While seed broadcasting methods have the potential to reduce labour and facility maintenance costs, this method has other costs such as the volume of seed lost to herbivory or wind. Broadcast seeding is also limited to seeds with germination requirements that are well-suited to this method of dispersal (Ceccon *et al.* 2016).

Due to these limitations, both tubestock plantings and broadcast seeding may be limited in their capacity to cost-effectively restore high biodiversity ecosystems or certain key plant functional groups (Kimball *et al.* 2015). Furthermore, many sites which require restoration are remote or have difficult-to-access terrain, further complicating restoration efforts.

## Flying flora! Drone seeding as an emerging technique in restoration science

In 2021, a team of researchers (led by Rachael Gallagher at Western Sydney University) received funding through an Australian Research Council Linkage Project to investigate the use of unmanned aerial vehicles (UAVs or 'drones') to implement large-scale biodiverse restoration. The team is partnering with AirSeed Technologies Pty Ltd (AirSeed), an Australian environmental restoration company, and will trial new applications of their drone fleet and associated technology (Figure 1a).

To increase establishment rates and provide an efficient delivery mechanism, AirSeed has developed Seed Pods (Figure 1b), where seeds are inserted into an organic pellet. These Seed Pods are then dispersed across pre-programmed areas using a custom-designed aerial



Figure 1. Images of a) AirSeed planting drone, b) germination of *Syncarpia glomulifera* from a seed pod. Photos: Charlotte Mills and Paige Lieurance

drone which can plant multiple species in one flight and up to 40,000 Seed Pods per day. The GPS location of each Seed Pod is recorded to facilitated by monitoring, which drones can perform using remotely sensed imagery and artificial intelligence. When combined with the customised planting drone, the Seed Pod technology can facilitate large scale biodiverse restoration plantings and is not limited by difficult terrain or remote site access. This style of drone seeding therefore has the potential to provide a practical, and cost-effective solution to accelerate restoration works.

Over the next four years, the Linkage team will work alongside their partners at the Royal Botanic Gardens and Domain Trust to undertake experimental field trials restoring diverse native vegetation on site at the Australian Botanic Gardens at Mount Annan (ABGMA) in south-west Sydney New South Wales (NSW) (Figure 2).

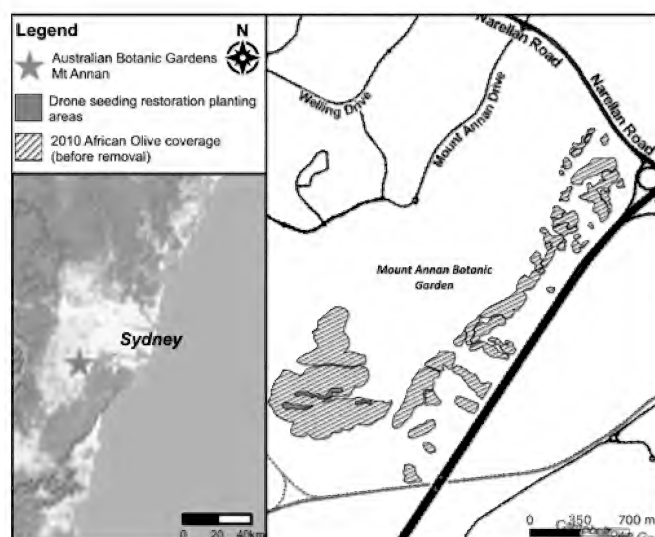


Figure 2. A map of the study area for this project.

## The science of Seed Pods

Multiple Masters of Research projects supporting the goals of the Linkage project are underway through partner institution Macquarie University. These projects are assessing the efficacy of AirSeed's Seed Pods for germinating native species, tracking emergence and/or growth and survival of a broad range of species using manipulative glasshouse trials.

The first of these projects is investigating which plant species targeted for restoration at Mount Annan will be amenable to drone seeding. Seedling emergence from Seed Pods relative to bare soils is being quantified for 30 species. With this data, the team will explore how seedling emergence is related to traits such as seed mass and dormancy. Preliminary findings show that larger seeded species may perform well in Seed Pods, as do species exhibiting a range of dormancy types.

Parallel projects are testing the role of microbial amendments in improving germination and growth of native plant species in Seed Pods. Results to date suggest that, compared to bare seeds, Seed Pods with and without probiotic amendments maintained high rates of emergence and noticeably improved growth for three of the four species tested (Alfonzetti *et al. in review*). Emergence in the fourth species was low in all seed treatments, perhaps due to the depth the seed was sown in all treatments. Interestingly, there were no discernible benefits in terms of increased emergence or growth detected in Seed Pods which incorporated the probiotic amendment.

Following on from this initial project on microbial amendments, a new project is testing the efficacy of additional probiotic and prebiotic amendments incorporated in Seed Pods across multiple native plant species. Preliminary observations from this work also suggest that AirSeed Seed Pods improve germination and growth compared to bare seed controls. Importantly, seeds embedded in Seed Pods which were inoculated with soil collected from reference sites at Mount Annan germinated faster than the control treatments. At the end of this trial, rhizosphere samples will be collected for DNA analysis to determine the microbial diversity of root-associated microbes.

## A field pilot program restoring sites following African Olive removal

Drone seeding is being trialled in the field to assist with restoration after removal of dense infestations of African Olive (*Olea europaea* ssp. *cuspidata*) at ABGMA. Historically, the pilot-study site once supported vegetation communities comprised of Western Sydney Dry Rainforest and Cumberland Plain Woodland species. However, past land-use history of clearing and grazing in the early 1900's left the landscape largely devoid of this native vegetation community and susceptible to invasion by African Olive.

African Olive is a woody tree that aggressively invades native vegetation, creating a dense canopy that restricts the growth of other plant species and poses a key threat to many ecological communities across Western Sydney (Cuneo & Leishman 2006). Estimates suggest the formidable weed once covered almost 20% of the 416-hectare ABGMA site (John Simeon, pers. comm.) Over the last decade, significant efforts have been made by the ABGMA team to reduce the coverage of African Olive across the landscape by approximately 85% via mechanically mulching the dense infestation (Figure 3). Following these efforts, ABGMA have partnered with various organisations to restore this landscape with native species.

This pilot trial aims to revegetate 1.4 hectares of ABGMA land recently cleared of African Olive using a suite of native species by testing the utility and cost-effectiveness



of AirSeed's Seed Pods technology compared to other well-established restoration methods (e.g., tubestock planting and seed broadcasting). The planting will include a taxonomically and functionally diverse selection of 29 species from various strata (canopy, midstorey, and ground cover) to mimic the species and structural diversity of Western Sydney Dry Rainforest and Cumberland Plain Woodland plant communities (Table 1). We will be monitoring the success of the pilot project using ground survey methods for emergence, growth and survival and by using aerial imagery from drones, which can be used to track growth, health and survival of the plants. The trial will also test the effectiveness in the field of three different Seed Pod 'recipes' which have been tested in the manipulative experiments described above. We will also compare emergence rates from Seed Pods sown in this field setting and those in a concurrent glasshouse experiment.



Figure 3. Image of the African Olive mechanical mulching process on the lower slopes of Mount Annan. Photo: Peter Cuneo

Table 1. A summary of Western Sydney Dry Rainforest and Cumberland Plain Woodland species chosen for restoration in this first trial organised by stratum (canopy, midstorey, and ground cover).

Species	Family	Canopy	Midstorey	Ground cover
<i>Acacia implexa</i>	Fabaceae	✓		
<i>Acacia parramattensis</i>	Fabaceae	✓		
<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	Pittosporaceae		✓	
<i>Calotis lappulacea</i>	Asteraceae			✓
<i>Chloris ventricosa</i>	Poaceae			✓
<i>Convolvulus erubescens</i>	Convolvulaceae			✓
<i>Corymbia maculata</i>	Myrtaceae	✓		
<i>Cymbopogon refractus</i>	Poaceae			✓
<i>Daviesia ulicifolia</i>	Fabaceae		✓	
<i>Dillwynia sieberi</i>	Fabaceae		✓	
<i>Dodonaea viscosa</i> subsp. <i>cuneata</i>	Sapindaceae		✓	
<i>Einadia hastata</i>	Amaranthaceae			✓
<i>Einadia nutans</i> subsp. <i>nutans</i>	Amaranthaceae			✓
<i>Eucalyptus crebra</i>	Myrtaceae	✓		
<i>Eucalyptus moluccana</i>	Myrtaceae	✓		
<i>Eucalyptus tereticornis</i>	Myrtaceae	✓		
<i>Eustrephus latifolius</i>	Asparagaceae			✓
<i>Indigofera australis</i>	Fabaceae		✓	
<i>Melaleuca styphelioides</i>	Myrtaceae	✓		
<i>Oxytes brachypoda</i>	Fabaceae		✓	
<i>Pandorea pandorana</i>	Bignoniaceae		✓	
<i>Pittosporum revolutum</i>	Pittosporaceae		✓	
<i>Poa labillardieri</i>	Poaceae			✓
<i>Solanum prinophyllum</i>	Solanaceae			✓
<i>Themeda triandra</i>	Poaceae			✓
<i>Wahlenbergia gracilis</i>	Campanulaceae			✓
<i>Microlaena stipoides</i>	Poaceae			✓
<i>Plectranthus parviflorus</i>	Lamiaceae			✓
<i>Clematis glycinoides</i>	Ranunculaceae		✓	



## Future directions

The results from this pilot trial will be used to inform and refine this methodology for larger field experiments at ABGMA and Western Sydney University starting in 2023. With the research in both the pilot and the larger field trials, we hope to develop a knowledge base of best practice principles to plan, implement, and evaluate drone-based seeding such that this practice can be used to upscale global land restoration. We will share this knowledge through a series of masterclasses to be held at ABGMA beginning in 2023. For more details, or to get involved in these classes, reach out to: [s.andres@westernsydney.edu.au](mailto:s.andres@westernsydney.edu.au)

## Acknowledgements

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# Enhancing bushfire recovery of Kangaroo Island's rare and threatened, endemic flora on private land and roadsides

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## Background

Kangaroo Island (KI) of South Australia has 29 endemic plant species which are rare or threatened. Many of these endemic taxa are confined to western Kangaroo Island, in areas which was extensively burnt out by bushfires in January 2020. Commencing 2020, the Nature Conservation Society of South Australia (NCS), in partnership with five other NGOs, undertook a study of postfire regeneration in 17 of these species, those that were significantly affected by these bushfires, including four species which were listed under the *Environment Protection and Biodiversity Conservation Act (EPBC Act)*. This project, funded by the Australian Government's *Wildlife and Habitat Bushfire Recovery program*, studied the mode and extent of postfire regeneration in these species, as well as threats to this regeneration. Using our finding we initiated recovery works involving volunteers, mostly students and KI locals.

Thirty-five small (mostly 4 m<sup>2</sup>) permanent quadrats and photopoints were set up on private land and roadsides, to monitor emergence and survival of seedlings and other propagules of these species. These were monitored from October 2020 to April 2021, a period which included two periods of well-below-average rainfall.

We used fire frequency data in NatureMaps to determine fire frequency at our monitoring sites and other sites where our target species survived. The effect of different fire severity on regeneration of the target species was determined using the "Minimum Stem Diameter" method (Perez and Moreno 1998).

## Effect of fire, drought, flood and climate change

Monitoring found that all 17 species were able to regenerate after the fire but that 13 were Obligate Seed Regenerators (OSR) *i.e.*, only able to regenerate from seed when burnt. Four regenerated only or mostly by reshooting from rhizomes. Three of the OSR we studied had occasional mature plants being protected from fire by limestone pockets ("live escapes"), this being the case for the EPBC-listed *Logania insularis*.

Inappropriate fire regimes were found to be a threat to a number of the target species. On the eastern end of KI, too-infrequent fires are threatening some species including the EPBC-listed *Leionema equestre* which is readily outcompeted by other understory species if left long-unburnt.

Conversely, on northwestern KI too-frequent bushfires is more the issue, some areas having been burnt up to eight times since 1931. We found that some rare, endemic species on the western end (*e.g.*, *Platysace heterophylla* var. *tepperi*, *Irenepharsus phasmatodes*) were fire successional and benefited from these high fire frequencies. Others such as the EPBC-listed climber *Cheiranthra volubilis*, were able to quickly regenerate and flower even after the most intense fire, by having deep perennial rootstocks (Davies *et al.* 2021).

In contrast, the EPBC-listed *Correa calycina* var. *halmaturorum* is likely threatened by increasing frequency and intensity of bushfires associated with climate change. Having a range of less than one square kilometre, almost the whole range of the taxon was burnt by the 2020 bushfire, with only 19 mature plants surviving, all confined to small unburnt refuges. Fifty eight percent of these were in unburnt remnants adjacent to the permanently flowing water of De Mole River. These were subsequently destroyed by flash flooding in February 2022 (Figures 1 and 2), a scenario also predicted to become more frequent with climate change (Davies *et al.* 2021; DEWA 2022b).

Over its whole range, we counted 470 *C. calycina* var. *halmaturorum* seedlings which had germinated after the fire and survived the flood. However, our monitoring indicated that such seedlings are vulnerable to increased heatwaves and droughts predicted with climate change. Seedlings in our monitoring quadrats declined by 45%, between December 2020 and April 2021 during the two periods of below average rainfall (Figure 3). In the future, with more severe droughts, De Mole River will likely dry up at times, reducing the chance that riparian remnants containing mature plant will survive unburnt in bushfires (Davies *et al.* 2021; DEWA 2022b).



Figure 1. Adult *C. calycina* var. *halmaturorum* plants on banks of De Mole River, December 2020. Photo: Richard Davies, UNSW



Figure 2. The same area in February 2022, after the flood. Photo: Richard Davies, UNSW

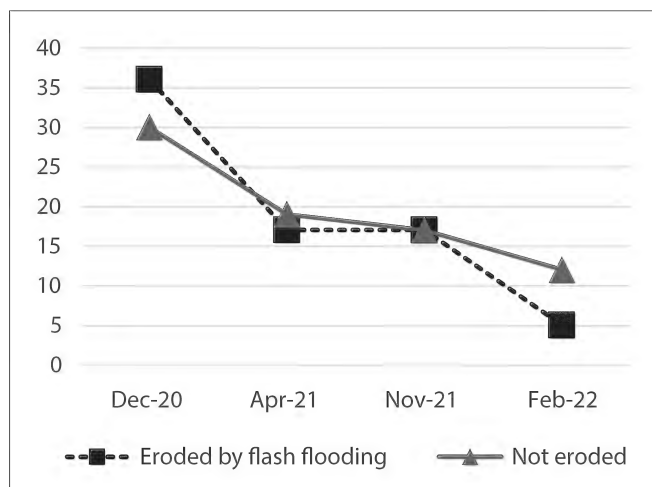


Figure 3. Numbers of seedlings of *Correa calycina* var. *halmaturorum* in parts of quadrat severely eroded by January 2022 flash flood, compared with parts of quadrat above flood level.

With droughts, heatwaves, and bushfires becoming more frequent, intense, and of longer duration, it will become increasingly difficult for seedlings of *C. calycina* var. *halmaturorum* to reach maturity and survive long enough to produce adequate seed. This is an important issue for this taxon being an obligate seed regenerator, and adult bushes being unable to reshoot after even cool burns (Davies *et al.* 2021; DEWA 2022b).

We also measured poor seedling survival over the summer dry spells in another two rare endemics: *Logania scabrella* and *Choretrum spicatum* ssp. *spicatum*. The latter species is a root parasite, and it is hypothesised that at drier sites, the seedlings are dependent on associated mature shrubs for water, these being absent in the first summer after a fire (Davies *et al.* 2021).

### Tasmanian Blue Gum

The biggest threat to rare and threatened endemic plants was found to be the invasion of Tasmanian Blue Gum (*Eucalyptus globulus*; TBG) spreading into conservation reserves, and other native vegetation, from adjacent burnt plantations. As part of the NCS project, over 50 volunteers hand pulled over 96,000 TBG wildlings (seedlings) from 46 ha of native vegetation adjacent to the rare and threatened endemic flora, along 16 km of roadside (Figure 4). This initial work was a catalyst for a number of other NGOs and state government agencies to continue this work.

We found densities of TBG wildlings a year after the fire to average over 900 wildlings/ha where burnt vegetation occurred adjacent to plantations, increasing to an average of 30,000 wildlings/ha in wet heath. Weeded sites required follow up weeding, with TBG densities being again 3000 wildlings/ha in wet areas, two months after initial weeding.

We found burnt watercourses to be particularly prone to TBG invasion with wildlings reaching over 2 m tall in the first year, up to 6m after two years, and spreading 600 m or more downstream. While wildlings could be initially hand pulled, cutting at the base was required for larger plants. Trials found that, while small (<1 m tall), this cutting did not require follow up swabbing with herbicide to be effective, if the cut was made at ground level, below the developing lignotubers (Davies *et al.* 2021).

### Other threats

Other threats identified, included weed invasion, hydrological change, and feral pigs. Of greatest concern was the observed decline, due to these factors, of the mat forming perennial forb *Asperula tetraphylla* which is listed as vulnerable under the *National Parks and Wildlife Act* (NPW Act) (SA). Known populations cover less than one hectare in total and are confined to oxbows and banks along only two river systems. Despite regenerating from a perennial root stock, the bushfires reduced the cover of the species which was subsequently severely impacted by weed invasion and feral pigs. While hand weeding



Figure 4. Volunteers hand pulling Tasmanian Blue Gum wildlings invading native vegetation containing rare and threatened endemic flora, after the 2020 bushfires on Kangaroo Island. Photo: Richard Davies, UNSW

and fencing enabled the cover of plants to temporarily double over summer at one site, subsequent flash flooding significantly reduced cover at this and other sites (Davies *et al.* 2021; DEWA 2022a). It is therefore being nominated for listing under the EPBC Act (DEWA 2022a).

Post-fire browsing of seedlings by over-abundant macropods (kangaroos and/or wallabies) was also identified as a risk, especially in a relict outlying population of EPBC-listed *Leionema equestre*, which was found to regenerate only by seed, where burnt by the January 2020 fire. Our monitoring showed seedling numbers declined by half over the first summer following the fire due to this and drought stress (Figure 3). However, NCS and partners on KI prevented further decline by constructing an enclosure around most of the population (1348 plants) in June 2021 (Davies *et al.* 2021).

Ongoing clearance of roadside vegetation during roadworks and the associated spread of *Phytophthora* was also identified as a threat to susceptible KI-endemic species. This soil borne root disease is becoming widespread on western KI, being spread during roadworks and the bulldozing of fire breaks. *Correa calycina* var. *halmaturorum* is one such species known to be susceptible. The susceptibility of other endemics is poorly known and in need of study. This particularly applies to the rare clonal species *Hakea aenigma* which does not produce seed. The species is potentially at threat being confined to a few localised populations in north western KI, a number of which abut roadsides where *Phytophthora* is prevalent (Davies *et al.* 2021).

## Acknowledgments

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# Engaging people in conservation and restoration

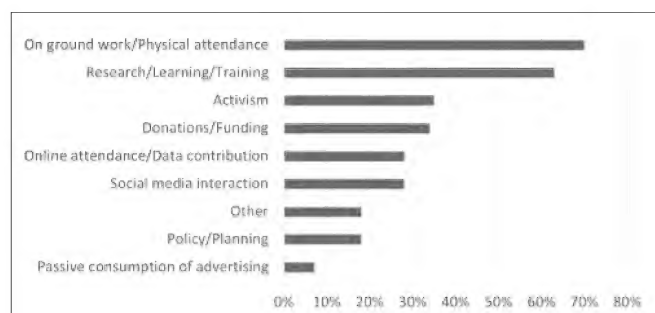
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Engaging people is, on the surface, an uncomplicated statement. We as practitioners are often required to 'engage' the public, peers, policy makers and funding bodies for reasons, primarily of funding, behaviour change and cost/labour savings. Belying this simple word is the trap – what is engagement? How do you know someone is engaged? Is it passive consumption of advertisements or does engagement require action? We ruminated on this very topic at this year's Australasian Plant Conservation Conference (APCC13).

In a survey of 71 attendees at APCC13, the consensus was 'engagement' is an active pursuit (Figure 1), where 70% of attendees identified 'On-ground work/Physical attendance' as an apt definition. This was closely followed by 'Active research/Learning/Training' (63%). Engagement is least consistent with passive consumption of advertising (7% of respondents). But is this really the case and could broadening our expectations of what constitutes engagement yield new, and exciting approaches to generating awareness or participation?

As the UN Decade on Restoration (2021–2030) enters year two, what constitutes engagement is a critical question. The 10 Actions of the decade (<https://www.decadeonrestoration.org/strategy>) all arguably rely to some extent on engaging the public, practitioners, and stakeholders. Concordantly the Partnership, Outreach and Communication Strategy focuses on creating 'engaged participants' through providing 'meaningful opportunities' that are specific to 'individual interests and needs' and offer opportunities



**Figure 1. Responses of 71 participants at APCC13, to the question "How would you define 'engaging' people in conservation or restoration?"**

relevant to 'varying levels of motivation, capacity, and loyalty.' Engaging these groups requires a tiered approach, a ladder of engagement, with the first rung being consumption of materials, and subsequent rungs being focused on sharing of content, production, and creation of content, through to direct funding and finally shaping and leading projects.

Based on this tiered approach, we can then expand our concept of what may or may not constitute engagement, based on a continuum of externally to intrinsically driven motivations (Sterling *et al.* 2017), and include less immediately considered methods of engagement, such as arts and storytelling (e.g., EcoArts), advertising (including fundraising and brand awareness), market driven initiatives (e.g., EcoTourism), social and emotional programs (e.g., EcoTherapy), and policy and planning. All of which have potential to foster some connection with our environment and subsequently conservation and restoration.

Following this expansion of what may constitute engagement, the question then is WHY would an individual or group engage in a brand, activity or project? The why has been explored frequently within numerous disciplines including psychology, behaviour change, economic development and planning, as well as conservation and restoration, because ultimately engaging people is a subjective human endeavour, regardless of end goal. A synopsis provided by Clary *et al.* (1998) details six functions of volunteering as potential motivations. These are 1) Values – altruism and concern for others, 2) Understanding – desire to learn, 3) Social – strengthen or build relationships, 4) Career, 5) Ego protective – escape from negative feelings and 6) Ego enhancement – personal growth and self-esteem. When we compare the functions of volunteering with the primary reasons for engagement, as voted by attendees of APCC13 (Figure 2), there is consistent overlap. Eighty percent (80%) of respondents citing a Desire to contribute and personal connection (76%) as primary drivers, followed by curiosity/learning (44%). These drivers address Clary's volunteer functions of values, understanding and enhancement. Ego protective motivations such as guilt rated low (30%), as did motivations related to career (professional requirement [13%], funding availability [7%], brand/prestige [7%]).



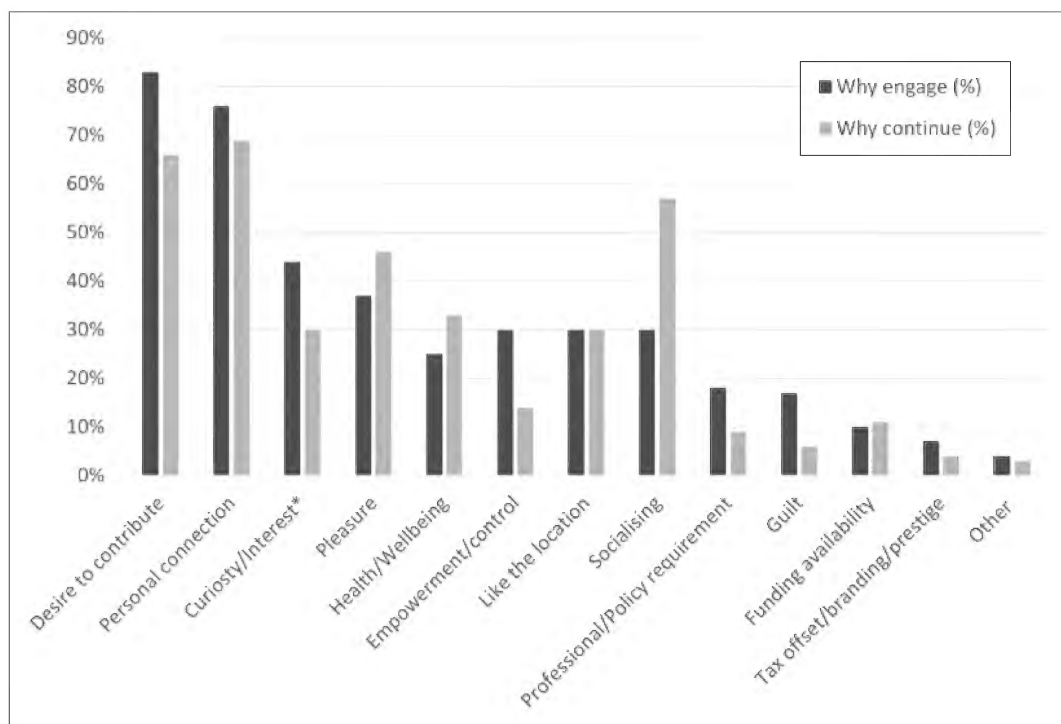


Figure 2. Responses of 71 participants at APCC13, to the question “Why do you believe people become engaged in a conservation or restoration project?” and “Why do you believe people stay involved in a conservation or restoration project?”  
\*Curiosity/Interest replaced by Habit/Routine for “Why do people stay involved?”

The fact that ego protective and career motivations were rated low by participants may reflect the nature of people involved in the sector, where conservation and restoration inherently attract individuals with a focus on altruism and emotional connections to natural places and spaces. This focus on altruistic contributions and personal connections as drivers is supported by Alender (2016) where ego enhancing motivations such as reputation and career growth again ranked very low in environmental volunteering.

One of the key concerns of any sector, particularly one involving volunteered contributions, is retention. Simply, why would people continue to engage in a project or process? Clary’s (1998) conclusion still holds truth, despite many decades of change. People continue when they receive benefits associated with their primary motivation. This is seconded by Wright *et al.* (2015) who found a linear relationship between initial motivation and satisfaction. Identifying primary motivations, however, is a challenge. Although feedback sought throughout the project lifetime (conception, planning, delivery, and conclusion) can be used to adapt project scope and delivery, in practice, competing requirements, time, budget and staffing can limit capacity. Nonetheless we as practitioners (and people!) should seek feedback, either informally or through formal anonymous surveys or focus groups to seek improvement in contributor satisfaction. Simple methods, such as acknowledgement, may be sufficient for contributors to feel valued (Alender 2016), along with an opportunity for contributors to feel part of a like-minded team or tribe (Wright *et al.* 2015). The social element of retention shouldn’t be undervalued. Although

socialisation as a driver of engagement didn’t rate highly in the APCC13 survey (30% of participants believing it was a reason people engage), 56% of respondents at APCC13 did feel socialisation was a driver of retention (Figure 2). This finding was strongly supported by Wright *et al.* (2015).

The key to retention may of course, be simpler again. Paul Ibbetson (pers. comm. November 2019, former NSW National Parks and Wildlife Service) distils his secret to a successful (and multi-decade) volunteer Bushcare Team. When asked why people kept coming back, he responded, “Show them a good time, give them goals they can achieve and the time to do it in...and a good morning tea. A packet of cheap Arnott’s biscuits is never going to do it. Good food and good coffee, that’s the glue that holds it all together.”

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# An update of the Florabank Guidelines: National guidelines for best practice native seed collection and use

LUCY E. COMMANDER

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When do we need native seeds? What do we need to know about them? Why do we need guidelines? You'll find the answers to these questions and more in the update of the Florabank Guidelines (Commander 2021).

The key message is that everyone associated with native seeds, from policy right through to planting, should read the Florabank Guidelines.

The Guidelines start by asking the question, when do we need seed for restoration? Different approaches are needed for restoration for different species and different places.

In some instances, seed is in fact not required. Sometimes removing threats to enable natural regeneration, such as fencing, may be sufficient, if the area has enough seeds in the seed bank, or plants can resprout, or seeds can return through dispersal. However, if the land is cleared, or highly degraded, seed inputs may be required to replace missing species or increase numbers. Often, a combination of approaches is needed to restore different species within the area. The Guidelines recognise the importance of *ex situ* conservation such as seed banking and nursery propagation to support *in situ* conservation activities such as seeding and planting.

But, once the decision to use seed has been made, there are so many more questions – like, which species, where do we source the seed from, how much do we need, what's the seed quality, how do we store it, how do we sow it? Best practice guidelines can help answer these questions.

The first edition was a set of ten Guidelines which was published in 1999/2000. This new edition, published in 2021, was expanded to 15 modules. It was produced as part of the ANPC's Healthy Seeds project, funded by the NSW Government through its Environmental Trust. Over 45 authors and over 50 reviewers were involved in its production, with many more invited to participate. In addition to the updated content based on the past two decades of research and practice, there are plenty of new photos (e.g., Figure 1), conceptual diagrams (e.g., Figure 2) and decision trees (e.g., Figure 3).



Figure 1. The Guidelines contain many new photos such as this showing examples of different fruit types. Top, left to right: follicle e.g., *Hakea* (Proteaceae); woody capsule e.g. *Eucalyptus* (Myrtaceae); legume e.g. *Senna* (Fabaceae); caryopsis e.g., *Amphipogon* (Poaceae); utricle e.g. *Atriplex* (Chenopodiaceae). Middle, left to right; non-woody capsule e.g., *Goodenia* (Goodeniaceae); achene e.g. *Streptoglossa* (Asteraceae); berry e.g. *Solanum* (Solanaceae). Bottom, left to right: fleshy drupe e.g., *Nitraria* (Nitrariaceae); schizocarp e.g. *Diplolaena* (Rutaceae); dry drupe e.g. *Eremophila* (Scrophulariaceae). (Photos: L. Commander, A. Quarmby) (from Commander 2021, Module 8, Figure 3).

The Guidelines follow the seed supply chain (Figure 4), with four supporting modules (three at the beginning and one at the end). Key points of each module are clearly outlined in an infographic on the first page. The modules are:

1. Introduction
2. Working with Indigenous Australians: Seed Knowledge, Partnerships, Intellectual Property and Permissions
3. Approvals, Principles and Standards for Seed Collection
4. Record Keeping
5. Seed Sourcing
6. Seed Collection
7. Seed Production
8. Seed Processing: Post-harvest Drying, Seed Extraction and Cleaning
9. Seed Drying and Storage

10. Seed Quality Testing
11. Seed Germination and Dormancy
12. Seed Enhancement Technologies
13. Nursery Propagation of Tubestock and Restoration Planting
14. Direct Seeding
15. Buying and Selling Seeds

Everyone who performs restorative activities, such as restoration, revegetation, translocation, tree planting and enhancing remnant vegetation is encouraged to read the Guidelines. This includes everyone in the seed supply chain (Figure 4), from pickers to planters, as well as botanic gardens, native nurseries, natural resource management organisations and landcare/bushcare groups. Those who support seed-based restoration, such as policy makers and funding organisations, as well as those in other decision-making roles, are also urged to read the Guidelines.

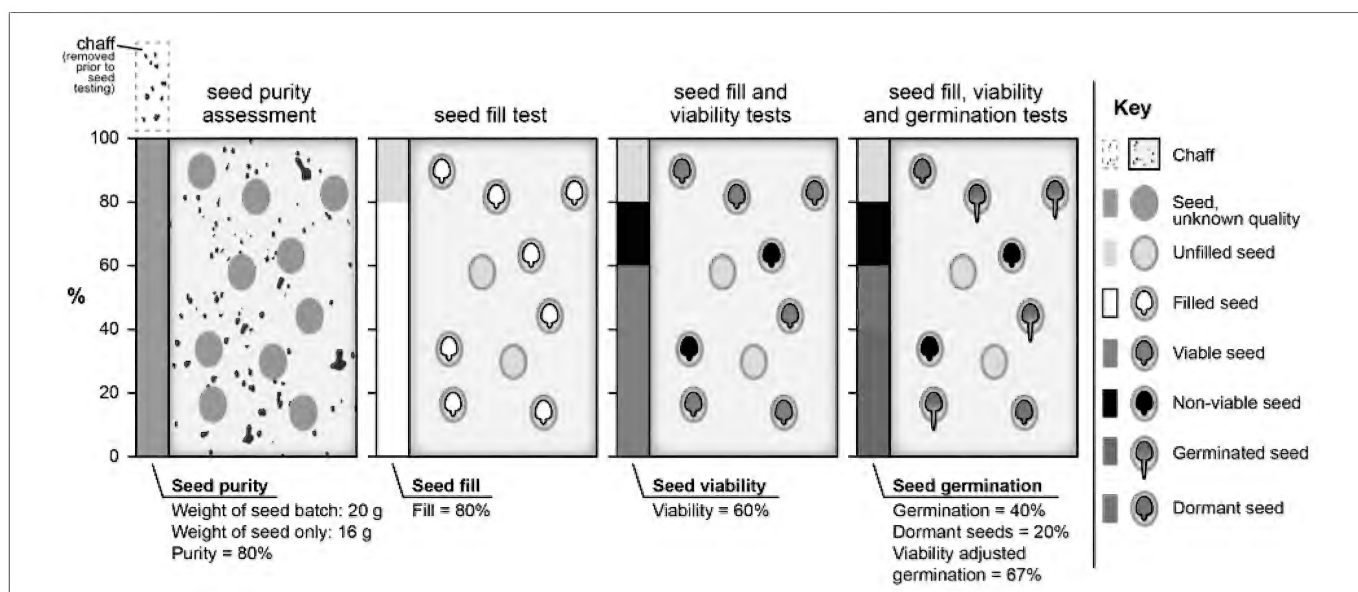
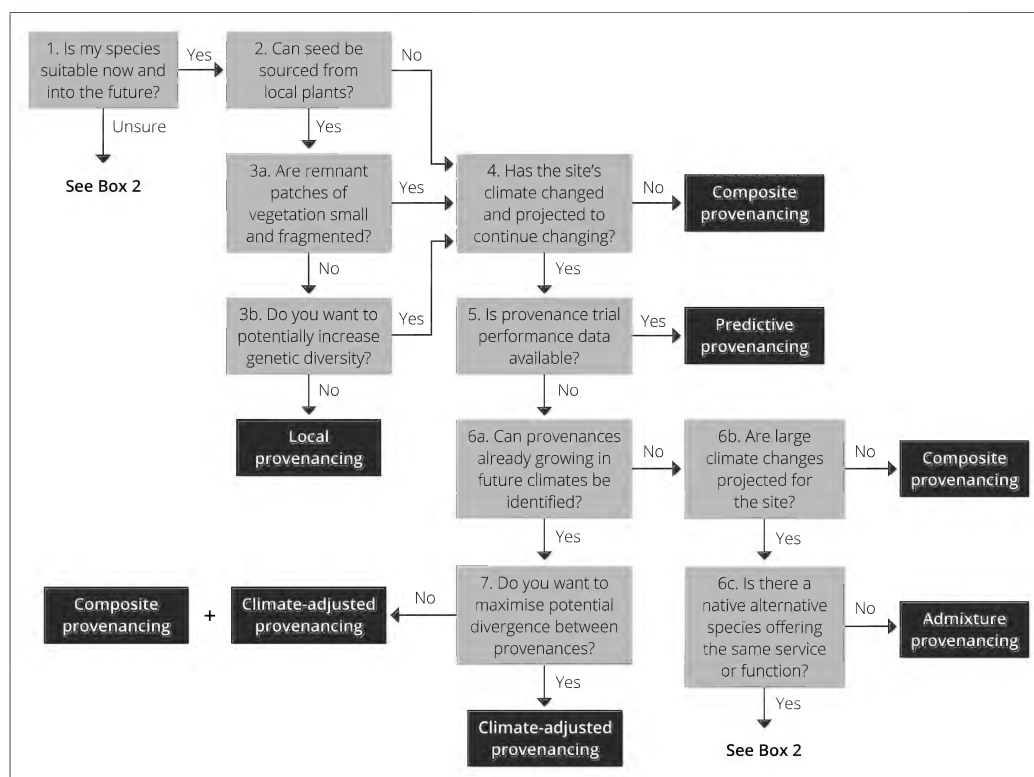


Figure 2. The Guidelines contain many conceptual diagrams such as this breakdown of the components of a seed lot, and how different seed tests can identify the different fractions. This hypothetical example shows the breakdown of each component, both as a stacked column graph and as a diagrammatic representation. Different tests (seed purity assessment, seed fill test, seed viability test, seed germination test) elucidate different components. (Figure courtesy of Craig Miskell, CAM Graphics) (from Commander 2021, Module 10, Figure 1).

Figure 3. The Guidelines contain several decision trees such as this generalised decision tree for choosing a potential provenancing strategy given the state of the local provenance and the site being restored. The decision tree gives a non-exhaustive list of questions one may ask when determining which provenancing strategy best matches requirements (from Commander 2021, Module 5, Figure 2).



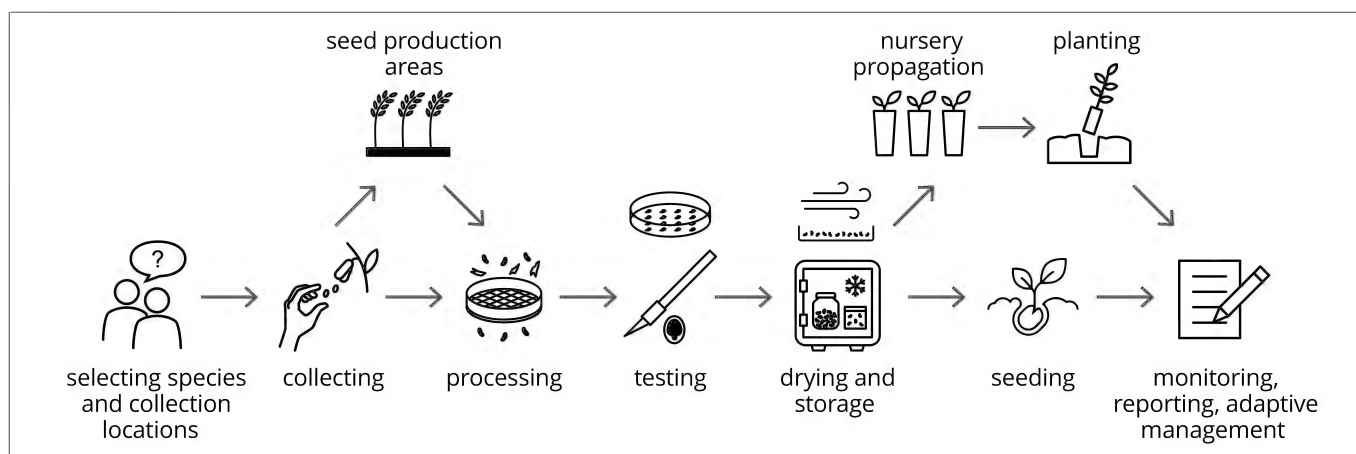


Figure 4. The seed supply chain (from Commander 2021, Module 1, Figure 8).

The Guidelines are an opportunity for knowledge sharing and collaboration between various parts of the seed sector; for knowledge to reach policy and end users; and to help improve ‘seed literacy’ across the sector and lift standards.

The Florabank Guidelines complement other ANPC publications, including the Translocation Guidelines (Commander *et al.* 2018) and the Germplasm Conservation Guidelines (Martyn Yenson *et al.* 2021).

The ANPC, CSIRO, Greening Australia and the Australian National Botanic Gardens are members of the Florabank Consortium, which is responsible for the Florabank website <https://www.florabank.org.au/>. The Florabank Guidelines are free to read and download from the Florabank website: [www.florabank.org.au/guidelines](http://www.florabank.org.au/guidelines).

## Acknowledgements

Thanks go to all the authors who generously volunteered their time, ANPC staff for their support, NSW Government for funding, the Healthy Seeds Consortium for their guidance, Siobhan Duffy for layout, and Craig Miskell for many of the graphics. Thanks also to Project Phoenix for funding the Florabank website which hosts the Guidelines.

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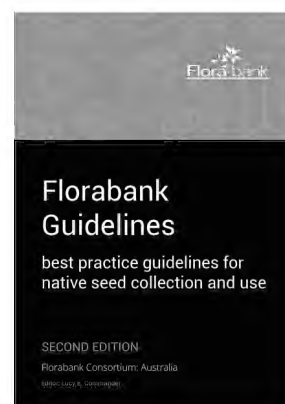
# Florabank Guidelines

## best practice guidelines for native seed collection and use

**Second Edition 2021 | Editor: Lucy E. Commander**  
**Florabank Consortium: Australia.**

The second edition updates the original Guidelines, incorporating new information generated by a further 20 years of research and practice.

For more information and to order, go to [www.anpc.asn.au/florabank/](http://www.anpc.asn.au/florabank/)



# News from the ASBP

*In this latest edition of News from the Australian Seed Bank Partnership we bring you a special article on behalf of the Council of Heads of Australian Botanic Gardens (CHABG) and Botanic Gardens Australia New Zealand (BGANZ). These two botanic gardens-focused organisations are collaborating on a project to better understand the collections of Myrtle Rust-affected species held in ex situ facilities throughout Australia. This article originally appeared online in the Winter 2022 edition of the BOTANIC GARDENER (Issue 58) - [https://issuu.com/bganz/docs/tbg\\_iss58\\_jun2022\\_final](https://issuu.com/bganz/docs/tbg_iss58_jun2022_final)*

## Fighting Myrtle Rust with gardens' data: which Myrtaceae already live in *ex situ* collections?

DAMIAN WRIGLEY<sup>1</sup>, BRETT SUMMERELL<sup>2</sup>, JOHN ARNOTT<sup>3</sup> AND EMMA SIMPKINS<sup>4</sup>

<sup>1</sup> National Coordinator, Australian Seed Bank Partnership.

<sup>2</sup> Chief Scientist and Director Research, Australian Institute of Botanical Science, Royal Botanic Gardens and Domain Trust, Sydney.

<sup>3</sup> Manager of Horticulture, Royal Botanic Gardens Victoria, Cranbourne.

<sup>4</sup> Botanical Records & Conservation Officer, Auckland Botanic Gardens.

Australian botanic gardens, their nurseries and seed banks hold diverse collections of native plants and germplasm, including many iconic species within the family Myrtaceae. Well-known Australian plants such as the lilly pillies, bottlebrushes, paperbarks and tea trees fall within this family, along with many others, conjuring images of some of the rich and diverse forests, swamps and coastal scrub where members of the family can be encountered. Myrtaceae also includes the iconic eucalyptus, a genus synonymous with the Australian landscape, possessing a wealth of species diversity and high levels of endemism.

This diversity and endemism across the eucalypts can be seen reflected, at least partially, in the living collections of botanic gardens, where morphological distinctions between species are often relied upon to highlight and illustrate the genetic complexity within the genus. Such collections, including those of other Myrtaceae, require targeted curation and long-term strategic management to maintain their health, rigour and relevance to public programs and conservation priorities. It would simply not be feasible to replicate these gardens' displays for all native Myrtaceae, particularly when it is estimated that over 80 genera within the family are endemic to Australia (Makinson *et al.* 2020).

With so many endemic Myrtaceae in Australia, alternative options for conserving them *ex situ* are needed. Many species not on display are already kept secure for the short-term in botanic gardens' nurseries, while other, more orthodox species rely on seed banks to provide a longer-term storage solution. Those species already secured *ex situ* in Australia and overseas in botanic gardens, nurseries and seed banks may be considered to be some of the luckiest family members.



*Melaleuca quinquenervia* heavily infected with Myrtle Rust *Austropuccinia psidii*. Photo: Geoff Pegg

With multiple human-induced pressures threatening the entire Australian flora, native plant species continue to be formally listed under federal, state and territory threatened species legislation at an alarming rate. On top of these cumulative threats, one clear and present danger is placing many species within the Myrtaceae at heightened risk of extinction, and this threat is spreading throughout the east coast and across the continent at a rapid rate.

Myrtle rust (*Austropuccinia psidii*) is a fungal pathogen known to have arrived in Australia in 2010. It spread rapidly throughout the east coast of Australia and east to New Zealand, presenting a major threat to the ability of many Australian species in the family Myrtaceae to survive and reproduce (Makinson *et al.* 2020). The arrival of Myrtle Rust has had a significant and detrimental impact on flora, prompting many to undertake extensive surveys and applied research to better understand the extent of this impact, and why some Myrtaceae are more resilient than others (Carnegie and Pegg 2018). Where funding has been available, further efforts by botanic gardens and seed banks have seen collections of germplasm provide some level of security for some of the most highly susceptible species (Summerell 2017).

In addition to *ex situ* collections, understanding the impacts *in situ* is critical to better targeting management responses. However, widescale management of Myrtle Rust *in situ* is untenable, particularly when considering the rate and mode of spread of fungal spores (Carnegie and Pegg 2018). Furthermore, the significant resources needed to manually treat infected populations to ameliorate fungal infection at scale makes this approach completely unrealistic within current knowledge and resources.

*Ex situ* collections of species in botanic gardens, their nurseries and seed banks present much smaller numbers of individuals than would normally be found in healthy, functioning *in situ* populations. These *ex situ* insurance populations can provide some level of hope for maintaining a species existence at the collection level, particularly when *in situ* populations are unable to reproduce due to infection. While *ex situ* collections usually require an intensive level of management to maintain their health, they also present opportunities for regular monitoring to potentially identify the early signs of infection and improve interventions with timely application of fungicidal treatments. With current advances in genetic tools, it is also possible to cost-effectively assess genetic variability in the *ex situ* collections and manage them to ensure we have the best chance of maintaining viable populations.

The comprehensive review of the Myrtle Rust issue, *Myrtle Rust reviewed* (Makinson 2018) and the recently released *Myrtle Rust – a draft national action plan* (Makinson *et al.* 2020) provide a thorough analysis of the threat of Myrtle Rust, and recommendations for the implementation

of a coordinated national response. The draft national action plan, while technically still draft, is providing much-needed guidance for the national response across practitioners, academia and government. The new Threatened Species Strategy (Department of Agriculture, Water and the Environment [DAWE] 2021) and its associated Action Plan 2021–2026 (DAWE 2022) identifies Myrtle Rust as a key threat to Australia's threatened species, with the *Myrtle Rust – a draft national action plan* providing necessary guidance for the implementation of this very welcome policy focus.



*Rhodamnia rubescens* cuttings in the Booderee Botanic Gardens nursery. Photo: Damian Wrigley

## How can botanic gardens, nurseries and seed banks get involved?

Biosecurity funding from the Australian Government's DAWE is supporting the Council of Heads of Australian Botanic Gardens (CHABG) and Botanic Gardens Australia and New Zealand (BGANZ) to undertake a stocktake of species in the family Myrtaceae that are already held in botanic gardens, their nurseries and seed banks. The stocktake will be performed through a survey that will be open to those across the BGANZ network with species from the family Myrtaceae in their collections. This information will be used to inform future prioritisation of Myrtle Rust-affected species and support the implementation of the Threatened Species Strategy Action Plan 2021–2026.

Myrtle rust experts across academia, botanic gardens, seed banks and government will help to inform the design of the survey, ensuring it captures the most pertinent information for shaping the future management of Myrtle Rust-susceptible species both



*in situ* and *ex situ*. Consultations with the BGANZ Collections and Records Management (BCARM) group will also help inform how the survey can reflect the differential access to resources and limitations that gardens may experience when collating and managing collections-related data. Once finalised, the survey will be distributed to BGANZ members to ascertain which species are held in collections, including whether provenance and the diversity of these collections can confidently be identified.

The survey results will be released at the end of 2022 and will be made freely available to BGANZ members and the public through the Atlas of Living Australia's MERIT portal. The information collected through this survey will enable botanic gardens, nurseries, seed banks and researchers to utilise this data in strategically planning and managing their collections as well as supporting further research. The survey results will also be shared with governments, business and the philanthropic sectors so that policy makers and funding bodies have additional information to assist in the prioritisation of future resources.

Botanic gardens, nurseries and seed banks hold substantial expertise and collections across Australia and with them a wealth of information about which species are already secured *ex situ*. By responding to the survey, you will be supporting the collation of critical information that can help to build support for future national coordination of projects that seek to tackle the threat of Myrtle Rust and save our endemic Myrtaceae.



Part of the *Rhodamnia rubescens* insurance collection at the Booderee Botanic Gardens nursery. Photo: Damian Wrigley



A healthy *Syzygium hodgkinsoniae* with no sign of infection (top), exhibiting significant infection with Myrtle Rust (bottom). Photos: Geoff Pegg

If you have questions about the survey, please contact Damian Wrigley at [coordinator@seedpartnership.org.au](mailto:coordinator@seedpartnership.org.au) or on 0418 955 661.

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# ANPC member profile

## Dr Rick Davies

### What is your current position?

I am a consultant botanist and part-time Research Fellow at UNSW (based in Adelaide)

### What projects are you working on at the moment?

While previously working as Threatened Flora Ecologist working for the Adelaide and Mt Lofty Ranges NRM Board, I was frequently asked to advise on optimum timing of prescription burns in areas containing threatened orchids. This led me to negotiate funding for PhD research into the effect of season of burn on a range of common orchid species in the Adelaide Hills, as surrogates for these threatened species. I am currently co-supervising this research through the UNSW.

Following the deadly bushfires which burn out almost half of Kangaroo Island in 2020, I obtained federal funding through the Nature Conservation Society of SA, for a major project, involving 50 volunteers, studying and mitigating threats to postfire regeneration of

rare endemic flora (see article this edition). I am now researching and writing EPBC Conservation and Listing Advices for a number of these species, again employed by UNSW.

On a different tack, I have just commenced a contract with the SA Arid Lands Landscape Board, studying the conservation biology of the endangered Arckaringa Daisy (*Olearia arckaringensis*) in the Painted Desert north of Coober Pedy. Browsing, small population size, and inbreeding depression are possibly threats being experimentally investigated for this species.

### How did you end up working in plant conservation?

In 1979, while traveling in northern America for a year and visiting numerous national parks, I found myself pondering the question: "how many national parks do you need to adequately conserve the world's biodiversity?" On returning to Australia, and resigning from high school teaching, I could hardly believe my luck landing a contract researching that very question.



Rick Davies (centre) with Arabana rangers and volunteers, monitoring *Eriocaulon carsonii* on mound springs near Lake Eyre.  
Photo: Christina Vaughan

This was a baptism by fire since it required me to comprehensively review all vegetation survey literature for South Australia, and survey vegetation communities in numerous newly proclaimed conservation reserves. The resulting report *The Conservation of Major Plant Communities in South Australia*, published in 1982, evaluated the conservation status of every major vegetation community in the state, and was used for a number of years in the assessment of clearance applications.

In the 1980s South Australian's threatened flora was poorly known so I next targeted these species with surveys, monitoring, and management plans funded by numerous grants. This culminated in my PhD on the conservation biology of the endangered mound spring endemic Salt Pipewort, *Eriocaulon carsonii*. Three post docs studying the effect of grazing and fire on soil seedbanks followed.

### What is your favourite plant and why?

My fascination with Salt Pipewort grew as my PhD progressed, this species requiring permanently wet feet but tolerates only very shallow water, while occurring in the hottest and driest parts of Australia, near Lake Eyre.

The most interesting facet is the species' molecular biology. The mound springs on which the species depends are clustered into spring *Groups* which are in turn clustered in *Complexes* and then *Supergroups*. Being a poor disperser, plants in each Supergroup are genetically distinct from the next, with levels of genetic diversity within different Supergroups, varying greatly. Variable rates of spring extinctions over the last century make the mound springs potentially valuable in the study of the effects of inbreeding depression and extinction debt.

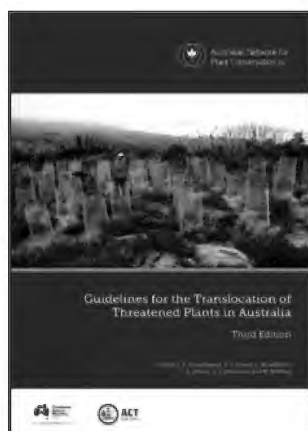
### Why do you think the ANPC network is important and what do you see as our priorities?

Given the general perception that endangered species are all mammals and birds, the ANPC plays an important role in educating the public on the importance of Australia's unique flora.

A high priority should be promoting targeted research into *in situ* conservation biology of threatened species. While it is also important to conserve species *ex situ* as seed, and undertake translocations where populations are perilously small, the long-term survival of a species *in situ* is dependent on understanding and ameliorating the threats that have caused to species decline in the first place. An important part of this is managing populations to promote natural *in situ* regeneration and recovery.

An example of this is newly completed PhD research\* on the conservation biology of the critically endangered *Hibbertia tenuis*. This showed experimentally the need for smoke to germinate seed, and both fire and protection from kangaroos browsing for *in situ* recovery. Prior to this research, recovery actions had concentrated on growing plants from cuttings and unsuccessfully planting these into dense swamp vegetation.

\* Trezise, J.E., Facelli, J.M., Paton, D.C. & Davies R.J.-P. (2020). The effect of heat and smoke on the soil seed banks of heathlands on permanent freshwater swamps. *Austral Ecology* 46: 39-51.



## Guidelines for the Translocation of Threatened Plants in Australia – 3rd Edition

Step-by-step information on how to do best-practice translocations, improve translocation success and contribute to preventing plant extinctions.

**3rd Edition 2018 | Eds L.E. Commander, D.J. Coates, L. Broadhurst, C.A. Offord, R.O. Makinson and M. Matthes. Australian Network for Plant Conservation, Canberra.**

For more information and to order a hard copy or download a free PDF copy, go to [www.anpc.asn.au/translocation](http://www.anpc.asn.au/translocation)

# Book review

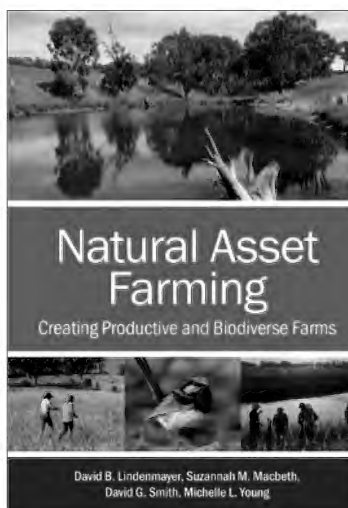
## Natural Asset Farming: Creating Productive and Biodiverse Farms

By David Lindenmayer, Suzannah Macbeth, David Smith, Michelle Young

Paperback; March 2022; \$44.99; ISBN: 9781486314836; 184 pages; Publisher: CSIRO Publishing

This book adds to the enormous number of publications that advocate the need, importance, and benefits of managing and improving natural assets across our agricultural landscapes. It concentrates on the agricultural landscapes of southeastern Australia where most of the authors' monitoring and research work has been centered over the past two or more decades. The book focuses initially on overall vision and planning and then on implementing works at various scales on key natural asset targets such as shelterbelts, plantings (but provides little in the way of examples or case studies of direct seeding and other restoration methodologies), remnant vegetation repair, paddock trees, native grasses, farm dams, creeks and watercourses and rocky outcrops. The book is well laid out, has well-presented photos and informative graphics and case studies on individual sites and theme outlines.

The book is targeted at landowners, managers, and extension workers in the field to demonstrate examples of what can and has been done, why, and the experienced benefits. It is an easy and informative read but I can't help feeling that the key readership is still going to be those that are already informed and active in the field. It would be hoped that more farmers and extension staff gain access to this publication, but this inspiration is just a small part of the equation to address these outcomes. The authors make the initial point that this book builds upon at least three decades of on-ground works, experience, research and monitoring and the hope that the book will enable more landholders to use this useful tool and the ideas it contains.



One of my key frustrations and concerns after reading this publication is that, after over three decades of knowing what can be done, and with decades of monitoring and publications justifying the benefits, we as a country and as a restoration sector are still not supporting and implementing these ideas at anywhere near the scale and extent that is required to address the issues. The real issue is that while there is individual interest and activity in protecting natural assets of our collective landscapes, the public policy and investment in supporting and fostering these natural assets has not increased over these three decades.

In fact, it is clear that there is individual farmer and land manager interest, desire and time investment into land asset management as highlighted in the case studies. But it is still thwarted by lack of public policy and investment into sustainable extension services, knowledge and careers in restoration, restoration infrastructure, seed supplies and direct seeding capability, fencing and works incentives that all provide the incalculable public benefit returns in biodiversity and sustainability (notwithstanding the individual benefits that can accrue) that this book advocates.

The message is loud and clear, every positive action (however small) can positively help our biodiversity, but we need to address the scale and systems of support to those who have the responsibility of managing the land. As identified in the book, there are many disincentives for farmers to take action, and it's easy to place many of these actions in the "too hard basket". We have to aim high, remove the disincentives and barriers, increase the incentives and provide the support systems, meaningful knowledge and extension from all these past learnings.

*Reviewer: Martin Driver*

# ANPC news and conferences

## APCC13

We'd like to thank everyone who attended the 13th Australasian Plant Conservation Conference in April. We had 91 people join us in Albury and 54 online attendees. We've received some great feedback so far that delegates enjoyed the presentation topics, had some great discussions and found the in-person networking really valuable.

## APCC13 Recordings

If you missed our conference in April you can now purchase recordings for all plenaries and workshop sessions. Head to our website to purchase access, there is a discount for our ANPC members.

<https://www.anpc.asn.au/product/apcc13recordings/>

## CPC National Meeting

In May, ANPC Project Manager Amelia Martyn Yenson shared an online presentation on the Germplasm Guidelines at the US Center for Plant Conservation National Meeting which had the theme "Celebrating conservation milestones". <https://saveplants.org/national-meeting/>

## Victorian Translocation Symposium

On Thursdays 21 and 28 July we held the Victorian Translocation Symposium. We had an incredible 299 people register with over a third of this number joining us online at any one time during each event. Thank you to everyone who joined us and for all our fantastic speakers, we appreciate you spending your time to share your expertise with our community.

The Symposium recordings are available to watch on the ANPC YouTube channel:

<https://www.youtube.com/watch?v=hEkl0e3Cxc&list=PLuPMH5OJZz0HDnhBdMvOoF8bFBOFT9MvQ>



## Plant Treasures In Conservation – Webinar 3

Recording available: [https://youtu.be/Zx1o\\_qMSXyo](https://youtu.be/Zx1o_qMSXyo)

On Thursday 12 May we held our third Plant Treasures webinar in collaboration with BCARM. This webinar featured an introduction from John Arnott, outlining the links between ANPC and BGANZ since their inception; and BGANZ as a resource for capacity building in botanic gardens of all sizes, especially to support smaller teams or individuals working on plant conservation in larger organisations. This is available as a separate short clip. <https://www.youtube.com/watch?v=NZU9kjJYF18>



The webinar also included:

- Lorraine Perrins at the Royal Tasmanian Botanical Gardens talking about the benefits of seed orchards for ease of access, monitoring and timing of seed collection, and bulking up seed numbers; and the time frame and challenges associated with curating seed orchards.
- Zoe Knapp at the Australian National Botanic Garden explaining the links between ANBG and partner organisations, the role of botanic gardens and importance of horticultural expertise in conservation, with examples from collaborative projects.
- Amanda Shade from Kings Park and Botanic Garden discussing biosecurity, including definition, implications for management of existing collections including quarantine, hygiene, monitoring and assessment and record keeping. Also the importance of surveillance programs such as the Botanic Gardens Biosecurity Network and the International Plant Sentinel Network.
- Sally Norton from the Australian Grains Genebank talking about conservation of crop wild relatives, the differences in handling cultivated species and crop wild relatives, and the challenges of regenerating collections in the field and nursery.

- Questions and answers for presenters and a panel discussion led by Michael Elgey, including discussion of collaborative projects such as TroMPS, the role of translocation, and the increasing focus on conservation in living collections strategies within botanic gardens.
- NEW Videos for the ANPC 'Plant Germplasm Conservation In Australia' playlist including the role of the nursery and living collections in plant management, cutting propagation in the conservation nursery, and collection and processing of fern spores. These are available as separate clips in our YouTube Germplasm playlist.  
[https://www.youtube.com/watch?v=BbYNUCdL\\_Uw&list=PLuPMH5OJZz0H4sZRy3vJ9nussmfStAlon](https://www.youtube.com/watch?v=BbYNUCdL_Uw&list=PLuPMH5OJZz0H4sZRy3vJ9nussmfStAlon)

### Plant Treasures In Conservation – Webinar 4

Recording available: <https://youtu.be/-XTQyNQ6uj0>

The fourth and final instalment in our Plant Treasures Webinar series was held on Thursday 9 June 2022 and gave an introduction to seed testing, germination and dormancy. Guest speakers for this webinar included Dr Lucy Commander, who managed the recent revision of the Florabank Guidelines, Dr Megan Hirst a Postdoctoral Fellow at the Royal Botanic Gardens Victoria and Deakin University and Dr Lydia Guja from the National Seed Bank who gave a talk on behalf of Dr Gemma Hoyle.

Both the Florabank Guidelines and Germplasm Guidelines include information on seed testing, germination and dormancy. These are useful for restoration seed banks, nurseries propagating Australian native plants and conservation seed banks. If you're not sure which guidelines you need, we have created a handy reference page: <https://www.anpc.asn.au/publications/choosing-which-best-practice-guideline-to-use/>

Lucy Commander explained how seed testing is an important part of the seed supply chain. Seed testing helps you understand whether you have filled, living seed – a handful of seed may only contain a small proportion of living embryos ready to grow! If seed is not tested, propagation or restoration failure can result, leading to wasted time and resources.

The Florabank Guidelines offer guidance on when to test, how to test, what equipment is needed and lists of online resources for further information.

Megan Hirst spoke about where to find species-specific information on seed germination and what kind of information you can use to plan successful germination tests (look carefully at the seed, its natural habitat and dispersal time – think like a seed!)

There are lots of different cues that help alleviate dormancy, such as heat shock and smoke, and these can be manipulated to improve germination results. Case studies in Chapter 7 of the Germplasm Guidelines offer insight into application of these techniques.

Gemma Hoyle and Lydia Guja walked us through the process of testing seed at the National Seed Bank at the ANBG. What do they do if seeds don't germinate? How do you know when to pursue further testing and what steps can you take to improve results?

If you work on temperate grassland communities, in particular, you will want to watch this talk and keep an eye out for the upcoming paper from the ANBG seed research team.





# Plant Cuttings

Editors' note: News excerpts are clipped from a diversity of sources. To read the articles in full follow the links attached to each clipping. The views expressed in these articles are those of their authors and do not necessarily represent the opinion of the ANPC.

## **Bruce Pascoe's farm – ABC RN, 7 May 2022**

Jonathan makes the trip to Mallacoota in far-eastern Victoria, land of the Gunai Kurnai people, to visit writer, historian, and Dark Emu author Bruce Pascoe. During a wander around the farm, they discuss native crops and grasses, food sustainability and farming and ducks.

<https://www.abc.net.au/radionational/programs/blueprintforliving/bruce-pascoe-farm-mallacoota/13870156>

## **Plants grow in lunar soil for the first time, as NASA plans for life on the Moon – ABC, 13 May 2022**

Scientists have used lunar soil collected during Apollo missions to grow plants for the first time. The results have been deemed promising enough that NASA is envisioning hothouses on the Moon for the next generation of lunar explorers.

<https://www.abc.net.au/news/2022-05-13/plants-grow-lunar-soil-moon-discovery/101064028>

## **Rare native plants ravaged by bushfires in Mallacoota make comeback in nursery sanctuary – ABC, 15 May 2022**

Two-and-a-half years after the catastrophic Black Summer bushfires devastated the Victorian town of Mallacoota, rainforest and coastal areas have slowly been coming back to life, with the help of a unique community nursery. Set up to grow seedlings for replanting around the township and wilderness areas, the Friends of Mallacoota Nursery was established to regenerate native species obliterated by fire.

<https://www.abc.net.au/news/2022-05-15/bushfire-raised-plants-regenerated-by-nursery-donated-seeds/101054592>

## **The environment and the election – ABC Late Night Live, 16 May 2022**

Australia is facing an extinction crisis, yet the environment has been almost completely absent from debates during the election campaign. What pledges and policies have the major parties announced when it comes to biodiversity and conservation, and what do those working in the field want the next federal government to prioritise?

<https://www.abc.net.au/radionational/programs/latenightlive/the-environment-and-the-election/13883890>

## **Volunteers plant 60 trees at Oldina farm in bid to tackle food security fears – ABC, 17 May 2022**

A group of passionate Tasmanians have a bold plan for their humble community garden plot and it all starts with 60 fruit trees. The Community Fruit Loops project is a multi-faceted joint venture being undertaken by the Country Women's Association, Live Well Tasmania and the Devonport Seed Library. The groups hope to address regional food security and, while they're at it, encourage social connections.

<https://www.abc.net.au/news/2022-05-17/northern-tasmanians-tackle-food-insecurity-with-community-farm/101069376>

## **These are the first plants grown in moon dirt – Science News, 23 May 2022**

That's one small stem for a plant, one giant leap for plant science. In a tiny, lab-grown garden, the first seeds ever sown in lunar dirt have sprouted. This small crop, planted in samples returned by Apollo missions, offers hope that astronauts could someday grow their own food on the moon.

<https://www.sciencenews.org/article/moon-dirt-plants-farming-regolith>

### **Jojoba seed dreams spur Narrabri farmer to plant thousands of trees – ABC, 23 May 2022**

The wax from the seeds of jojobas trees are used in a wide range of beauty products and as a substitute for oils. With 55 per cent of the seed being liquid wax, those in the industry say it is similar to the oil in your skin which makes jojoba a gentler and more environmentally-friendly alternative. Ms Felton-Taylor has just finished planting her first trees on her Narrabri farm.

<https://www.abc.net.au/news/rural/2022-05-23/jojoba-farmer-plants-first-trees-narrabri/101069518>

### **Discovery of rare orchid halts \$10m funeral home development in NSW – ABC News, 31 March 2022**

The discovery of a rare species of orchid on the New South Wales South Coast has stymied plans for a multi-million-dollar crematorium development. Murphy Funeral Homes has withdrawn its proposal after 101 leafless tongue orchids were found on the 60-acre property on The Wool Road at St Georges Basin.

<https://www.abc.net.au/news/2022-03-31/discovery-of-rare-orchid-stymies-10m-crematorium-development/100954222>

### **03 Shifting Cultures | Saving our species – ABC RN, 25 April 2022**

Australia is famous for its unique wildlife and landscapes. But we also have the highest mammal extinction rate in the world, and there are big declines in frogs, reptiles, and birds caused by introduced predators and land clearing. Some species are hanging on in small numbers on private land. Could paying farmers and Indigenous landowners to return parts of their properties to nature or turn them into carbon farms help solve our biodiversity crisis?

<https://www.abc.net.au/radionational/programs/earshot/saving-our-species/13809204>

### **Shifting Cultures | Healing with fire on koala country – ABC and BBC World Service 18 April 2022**

Australia's Black Summer bushfires killed billions of native animals and brought one of the country's most iconic species closer to the brink of extinction. But another legacy of the bushfires has been a groundswell of support for traditional Aboriginal fire management practices. On sacred country, in the land of the Yuin people, cultural burning is being reintroduced to protect the habitat of the last known koala population on the far south coast of NSW. This story travels to the lands of the Yuin people with Lesley Walker-Briggs to learn how fire can bring the land back to life.

<https://www.abc.net.au/radionational/programs/earshot/healing-with-fire-in-koala-country/13809152>

### **'I've never seen that before': Lord, how do you get rid of 200,000 rats on an island? – The Sydney Morning Herald, 22 April 2022**

The rats were relentless, said Hank Bower, who has lived on Lord Howe Island for 15 years. At night, they would run up and down the trees, eat food, destroy gardens, destroy the native environment and push animals to extinction. As if to taunt those on the island, they would also leave paw prints in the sand in the morning.

<https://www.smh.com.au/environment/sustainability/i-ve-never-seen-that-before-lord-how-do-you-get-rid-of-200-000-rats-on-an-island-20220421-p5af7s.html>

### **The Where and What of Howe – Gardening Australia, 22 April 2022**

Jane Edmanson visits Lord Howe Island, located 600km off the Australia Coast east off Port Macquarie and is part of NSW. The island formed nearly 7 million years ago when there was a volcanic eruption and is 11km long by 2km wide, and its estimated to be eroded to just a reef in 200 million years' time, which is quite quick in geological terms.

<https://www.abc.net.au/gardening/factsheets/the-where-and-what-of-howe/13848208>

### **Advice to the minister – April 2022 DAWE**

'Fire regimes that cause declines in biodiversity' as a key threatening process came into effect under the Environment Protection and Biodiversity Conservation Act 1999 from 21 April 2022. Find out more here <https://www.awe.gov.au/environment/biodiversity/threatened/key-threatening-processes/fire-regimes-that-cause-declines-in-biodiversity>

### **Tiny mite shows promise as biological control agent to fight Australian swamp stonecrop in UK and Europe – CABI News, Feb 8 2022**

A new study led by CABI scientists has confirmed that a tiny mite, *Aculus crassulae*, shows promise to be used as a more environmentally-friendly biological control agent against the aquatic weed *Crassula helmsii* in the UK and Europe.

<https://www.cabi.org/news-article/tiny-mite-shows-promise-as-biological-control-agent-to-fight-australian-swamp-stonecrop-in-uk-and-europe/>

### **Interstate rivalry heats up among gum tree enthusiasts for Eucalypt of the Year title – ABC News, 10 March 2022**

There's a heated competition between states in Australia at the moment, vying to take out the title of Eucalypt Of The Year for 2022. Western Australia is a favourite, home to defending champion the "sexy gum" (*Eucalyptus salubris*). Ecologist Michael Whitehead campaigned for the eucalypt, found in WA's Great Western Woodlands last year.

<https://www.abc.net.au/news/2022-03-10/interstate-competition-heats-up-for-tree-eucalypt-of-the-year/100893346>

### **Write a poem to plant a tree with Poem Forrest Prize – RN Breakfast, 25 March 2022**

The Poem Forrest Prize is an annual youth nature-writing competition, where a tree is planted for every poem written by students across the country. The project is in its second year, last year five-thousand trees were planted thanks to five-thousand poems.

<https://www.abc.net.au/radionational/programs/breakfast/write-a-poem-to-plant-a-tree-with-poem-forrest-prize/13812412>

### **Insider blows whistle on Australia's greenhouse gas reduction schemes – ABC News, 24 March 2022**

There are few people in the world of carbon credits and emissions reduction policy with the credibility of Andrew Macintosh. He's also been a go-to expert for the Coalition government, serving on its bushfires royal commission panel, the Climate Change Authority and its review into offsetting emissions by heavy industry and agriculture.

<https://www.abc.net.au/news/2022-03-24/insider-blows-whistle-on-greenhouse-gas-reduction-schemes/100933186>

### **Roadside trees stitch the ecosystems of our nation together. Here's why they're in danger – The Conversation, 29 March 2022**

You may know of marvellous tree-lined roads that lead into your favourite rural and regional towns. Sometimes they have an arched, church-like canopy, while others have narrow ribbons of remnant vegetation. But have you noticed they've changed over the past decade? Some have gone, some have thinned and others are now declining. This is because in general, roads are not safe places for plants and their ecosystems.

<https://theconversation.com/roadside-trees-stitch-the-ecosystems-of-our-nation-together-heres-why-theyre-in-danger-175337>

## Events and opportunities

### VIDEO: ANPC and BGANZ quick history

During the third webinar in our Plant Treasures series John Arnott (Curator of horticulture at the Royal Botanic Gardens Victoria and BGANZ Council Representative for Victoria) gave a brief overview of the history of the Australian Network for Plant Conservation Inc. (ANPC) and Botanic Gardens Australia and New Zealand Inc. (BGANZ). Have a listen: <https://www.youtube.com/watch?v=NZU9kjYF18>



### Australian Association of Bush Regenerators (AABR) YouTube channel

If you're looking for informative content on bush regeneration check out the AABR YouTube channel. You'll also find recordings of their webinars here, including their recent webinar 'Innovations in the Chemical Management of Vertebrate Pests'. <https://www.youtube.com/c/regenTV>

### New ESA Research Chapter

The Ecological Society of Australia has launched the Australian Vegetation Classification Research Chapter. This chapter consists of botanists, vegetation scientists and ecologists from across government, the private sector and academia. They aim to progress vegetation classification in Australia through vegetation plot dataset analysis and building the profile of Australian vegetation types internationally.

<https://www.ecolsoc.org.au/category/research-chapters/australian-vegetation-classification/>

### Flora Connections

Australia has a wealth of unique plant species, with many plants found nowhere else in the world. To protect these plants we need to know what is happening on the ground, and how plants across Australia are faring against threats such as habitat loss, disease, fires and floods. Citizen scientists, bushwalkers and botany groups have on-ground knowledge of what's happening to plants in their area. A new citizen science project, Flora Connections wants to connect this community plant knowledge to conservation decision making. Flora Connections provides guides and a data sheet to collect information on plant species- where the plant is growing, how many plants there are and what the threats to the plant might be. Data can then be uploaded via the website to the Atlas of Living Australia, where it will be used by the scientific committees and land managers trying to protect plants across Australia. Visit [floraconnections.com](http://floraconnections.com) to learn more, and print out a data sheet and get involved!

## ESA Joint Conference

The conference of the Ecological Society of Australia and the Society for Conservation Biology Oceania will be held in Wollongong, NSW from 28 November to 2 December 2022. ESA-SCBO 2022 will be an in-person conference but a limited number of online options will be offered, including live-streamed plenaries, some live-streamed symposia and some of the presentations being made available online after the conference.

<https://www.esascbo2022.org.au/>

## 7th Global Botanic Gardens Congress – Melbourne – Sept 2022

The 7th Global Botanic Gardens Congress will be a joint BGCI/BGANZ Congress, hosted by Royal Botanic Gardens Victoria, held at the Melbourne Convention and Exhibition Centre in Melbourne, Australia. To be held 25 – 29 September 2022. For more information please visit the congress website [www.7gbgc.org/](http://www.7gbgc.org/)

## SER Webinar Library

Have you seen the Society for Ecological Restoration's webinar library? All SER members have access to the library with a range of webinars presented by SER, regional chapters and partners. Check it out at <https://www.ser.org/page/WebinarLibrary>





## ANPC Corporate Members

ANPC gratefully acknowledges the support of the following corporate members:

**Albury Botanic Gardens, NSW**

**Australian National Botanic Gardens, ACT**

**Austspray Environmental Weed Control Pty Ltd, QLD**

**Ballarat Botanical Gardens, VIC**

**Botanic Gardens of Adelaide, SA**

**Centre for Australian National Biodiversity Research, ACT**

**Department of Biodiversity, Conservation  
and Attractions, WA**

**Department of Planning, Industry and  
Environment, Saving Our Species, NSW**

**Environment, Planning and Sustainable  
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**Naturelinks, VIC**

**Department of Environment and Science, QLD**

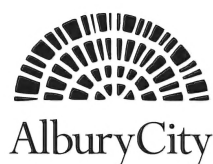
**Royal Botanic Gardens and Domain Trust, NSW**

**Royal Botanic Gardens Victoria, VIC**

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# Plant Germplasm Conservation in Australia:

*Strategies and guidelines for developing, managing and utilising ex situ collections (Third edition)*

Martyn Yenson AJ, Offord CA, Meagher PF, Auld TD, Bush D, Coates DJ, Commander LE, Guja LK, Norton SL, Makinson RO, Stanley R, Walsh N, Wrigley D, Broadhurst L (Eds.) (2021)



The fully revised third edition of *Plant Germplasm Conservation in Australia* is now available. Head to the ANPC website to download the guidelines for free or order a hard copy  
[www.anpc.asn.au/germplasm-guidelines-review/](http://www.anpc.asn.au/germplasm-guidelines-review/)



## Launch of the Plant Germplasm Conservation in Australia...

Australian Seed Bank Partnership



## Collection, processing and storage of fern spores

Australian Network for Plant Conser...



## Cutting propagation in the conservation nursery

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## Using differential scanning calorimetry (DSC) to identify...

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## Our national plant treasures: Australia's native plants and...

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For more resources visit the ANPC YouTube channel and browse our playlist Plant Germplasm Conservation in Australia.

You'll find our webinar series 'Plant treasures - in conversation', technique specific videos and more!

<https://www.youtube.com/c/AnpcAsnAu>